OUTLINES

OF A

COURSE OF LECTURES

ON

NATURAL & EXPERIMENTAL PHILOSOPHY.

BY T. GARNETT, M.D.

Member of the Royal Medical, Phyſical and Natural Hiſtory Societies
of Edinburgh, the Literary and Philoſophical Society of Mancheſter,
the Medical Society of London, the Royal Iriſh Academy,

LECTURER ON PHYSICS AND PHILOSOPHY IN PROFESSOR
ANDERSON'S INSTITUTION, GLASGOW, ETC.

> *Philosophia Naturalis scripta est in maximo, isto libro, qui continue nobis ante Occulos jacet appertus (universum hoc ajo) sed nihil aut legi, aut intelligi poterit, nisi prius addiscatur idioma, quo exaratum est.*
>
> GALILÆUS.

GLASGOW,
PRINTED IN THE COURIER OFFICE, BY W. REID & CO.
1796.

OUTLINES, &c.

INTRODUCTION.

UTILITY of Natural Philoſophy. The pleaſure it affords to the mind. Philoſophy favorable to true religion. The Utility of its various branches pointed out; particularly, Aſtronomy, Electricity, Magnetiſm, Pneumatics, Hydroſtatics, Hydraulics, and Optics. Neceſſity of a knowledge of Natural Philoſophy to thoſe who ſtudy medicine. A view of the cauſes which have retarded the progreſs of Philoſophy. Obſervations on Newton's rules for philoſophizing. Of the nature and extent of human knowledge. Demonſtration. Analogy. Of the nature of cauſe and effect.

SECT. I.

OF THE PROPERTIES OF MATTER, &c.

Diviſion of the material world. Mechanical philoſophy. Chemiſtry. Phiſiology.

Of Matter—its properties, viz. extenſion and diviſibility, impenetrability, inertia, attraction, motion and reſt. Our ideas of impenetrability leſs certain than we have ſuſpected. It is highly probable that the tangible particles of matter are not in contact, but are connected by mechanical forces, which, like gravity, act at a diſtance. Theory of Father Boſcovich.

Attraction—of coheſion—of gravitation. Magnetic and electric attraction and repulſion. Attraction of coheſion particularly conſidered. Various inſtances of this force. Dr. Hamilton's theory of the action of capillary tubes conſidered; objections to it. This force extends to a very ſmall diſtance between the particles of bodies. Chemical attraction or affinity illuſtrated by experiments.

SECT. II.

OF ASTRONOMY.

Antiquity of this ſcience: its utility:—inſpires us with the moſt ſublime ideas of the Creator.

Spherical figure of the earth proved from the voyages of the celebrated circumnavigators, Sir Francis Drake, Lord Anſon, and Capt. Cook; from the appearance of diſtant objects at ſea; from the ſhadow of the earth, during an eclipſe of the Moon.

The earth's roundneſs no more affected by the largeſt mountains, than the roundneſs of a common globe by the duſt thrown upon it.

Solar System.—The ſun is a large body, placed in the midſt of an immenſe ſpace, having ſeven planets moving round him, viz. Mercury, Venus, the Earth, Mars, Jupiter, Saturn, and the Georgium-Sidus, or Herſchell:—explained by means of the globes, orrery, &c.

A TABLE OF THE SOLAR SYSTEM.

NAMES OF THE PLANETS.	Diſtance from the Sun, in Miles.	Diameter in Miles.	Time of Revolution. D.	H.	M.	Diurnal Rotation. H.	M.	Number of Moons.
Mercury	31,671,900	2782	87	23	15½	unknown		
Venus	59,181,700	6637	224	16		23	32	
Earth	81,818,400	6975½	365	6	9¼	23	56	1
Mars	124,666,000	3617	686	23		24	39	
Jupiter	425,536,000	76982	4332	8		9	56	4
Saturn	780,395,100	68238	10761	14		unknown		7
Georgium Sidus	1,557,350,000	30130	30445	18		unknown		2

The diameter of the Snn is 763,000 miles,
and that of the moon 1214 miles.

No ſuch thing as abſolute up and down; but only relatively ſo. Gravity attracts bodies in lines tending to the center of the earth. Towards the center of the Earth we therefore call downwards, and from it, upwards, in every part of the world. The orbits of the planets are not all in the ſame plane. Nodes, Orbits, not circular but eliptical, having the Sun in one focus. Secondary Planets, Moons, or Satellities: Saturn's ring: the Planets are all opake bodies, ſhining by the light of the Sun which they reflect. Proofs that the different planets move round the Sun.

Annual and diurnal rotation; how aſcertained. Comets. Change of ſeaſons accounted for, and illuſtrated by Ferguſon's paradox. The Globes and Orrery. Phaſes of the Moon. Harveſt Moon. Eclipſes. Velocity of light. Cauſes of the Planetary Motions. Of the Fixed Stars. Conjectures concerning a plurality of Worlds. Method of ſolving Problems on the Globes. Improved Globe and Quadrant.—The motions of the Planets round the Sun, and thoſe of the ſecondary Planets round their reſpective primaries; the Eclipſes of the Planets and their Satellities: the Phaſes and Teleſcopic appearances of the Moon; and a variety of Celeſtial Phenomena exhibited on the Lucernal, or portable Eidouranion, which is the neareſt approach to magnificent ſimplicity of nature that ever was imagined.

SECT. III.

OF ELECTRICITY.

Hiſtory of Electricity. Attraction and repulſion. Spark. Of conductors and electrics. Of the electrical machine. Phænomena of electrified conductors. Poſitive and negative electricity. Many of thoſe electric phenomena which are generally thought to depend on repulſion do really depend on attraction. Directions for uſing the electrical machine. Imparted or communicated electricity. Inſulation of bodies. Theory of electricity. Hypotheſis of Dr. Franklin. Charged electrics. Leyden phial; accumulation of electricity in it. Electric ſhock. Electrical battery. The force of the ſhock in glaſs of the ſame thickneſs, proportional to the quantity of coated ſurface. Experiments for determining the velocity of the electric fluid-inconcluſive. Nature of the electric fluid—not the ſame with heat,—moſt probably a fluid ſui generis. Drawing ſparks—depends on the air being charged. Luminous points and pencils of light. Star. Though the ſpark appears a long extended line, yet it is probable that the electric fluid proceeds in a ſeparate and nearly globular body. Of electrometers. Of the electrophorus; theory of it; its force recovered by itſelf.

EXPERIMENTS.

1. The electrified cork ball electrometer. 2. The animated feather. 3. Attraction and repulſion of light bodies, with the dancing figures. 4. The electrical flaſh, between two metallic plates. 5. Inflammable ſpirits and other combuſtible bodies fired by electricity. 6. The aurora borealis imitated. 7. The card pierced by electricity. 8. Gunpowder fired. 9. A jar diſcharged ſilently. 10. The Electric fly. 11. The electrified cotton. 12. The electrified capillary ſyphon. 13. The ſpider, ſeemingly animated by electricity. 14. The illuminated tube and plate. 15. The magic picture. 16. Melted wax electrified. 17. The electrical piſtol. 18. Luminous ſpark. 19. Electric bells, &c. &c.

Of electricity without evident friction—inſtanced in evaporation, combuſtion, melted ſulphur, ſilk ſtockings, tourmalin.

NATURAL ELECTRICITY.

The torpedo; its ſurpriſing properties depend upon electricity: Mr. Walſh's theory of it. Theory of thunder and lightning. Identity of lightning and electricity proved by Dr. Franklin. Sig. Volta's theory of the manner in which clouds become electrified. Of the ſound produced by lightning. Sheet lightning generally inoffenſive: zigzag more dangerous: that which appears in the form of balls moſt ſo. Seeming omnipreſence of lightning. Method of aſcertaining the diſtance of thunder. Protection from the dangerous effects of lightning. Conductors—pointed and blunt. Of perſonal ſecurity. Many other atmoſpherical phenomena depend upon electricity; ſuch as aurora borealis, ſhooting ſtars, balls of fire, ignis fatuus, water ſpouts, and frequently earthquakes.

MEDICAL ELECTRICITY.

Method of adminiſtering it. In what diſeaſes to be uſed. Animal Electricity. Principal facts. Experiments with zinc and ſilver.

SECT. IV.

OF MAGNETISM.

The ſubject little known. Hiſtory of the loadſtone. Magnetiſm was thought to be confined to iron and ſteel, but it now appears that nickel when purified from iron, becomes more magnetic. Artificial magnets preferable to natural ones. Leading facts. 1. A magnet arranges itſelf in a determinate poſition. Poles. 2. A bar of iron which has ſtood a long time in a horizontal poſition becomes magnetic. Mariner's compaſs. Different degrees of magnetiſm diſcovered by experiment. The diſſimilar poles of two magnets attract each other, and their ſimilar poles repel each other. Strength of a magnet greateſt at the poles, proved by its ſupporting the greateſt weights from thence; by an experiment with iron filings; by the dipping needle. Courſe of the fluid ſhewn by experiments. Dip of mariner's needle. Magnetiſm communicated to iron. Directions for making artificial magnets. Magnetiſm ſooneſt acquired and loſt by ſoft ſteel; moſt ſlowly by hard. Magnetiſm exerted through all ſubſtances except iron. Magnetic attraction and repulſion decreaſes as the diſtance increaſes. Reaſon of the dip of the needle. Variation of the compaſs—not conſtant. Variation different in different latitudes.

At London the variation before the year 1657, was eaſt. In that year there was no variation. In the year 1665, 1 deg. 22 min. weſt. A. D. 1683, 4 deg. 30 min. W. A. D. 1700, 8 deg. W. A.D. 1744, 14 deg. 50 min. W. A. D. 1776, 21 deg. 47 min. W.

At Paris, before A.D. 1666, the variation was eaſt. In that year there was none. A. D. 1670, 1 deg. 30 min. W. A. D. 1700, 8 deg. 12 min. W. A. D. 1776, 19 deg. 45 min. W. At Glaſgow, the mean variation, A. D. 1775, was 24 deg. 21 min. A. D. 1776, 24 deg. 30 min. A. D. 1778, 24 deg. 32 min. W.

Diurnal variation. Needle diſturbed by the aurora borealis. Dr. Halley's theory of the variation of the compaſs. Theory of Æpinus. Walker's theory. Theory of diurnal variation. Promiſcuous experiments. Similarity of electricity and magnetiſm pointed out. The magnetic as well as the electric fluid prefers a ſhorter conductor to a longer. Proved by a curious experiment. Animal magnetiſm.

SECT. V.

OF PNEUMATICS.

Air. Proofs of its materiality; of its weight; Specific gravity; preſſure ariſing from the weight of air, equal to near 15 pounds on a ſquare inch. Riſe of water in pumps and ſyphons. Toricellian experiment. Barometer: connection between the height of the barometer and the weather. Method of determining the height of mountains. Deſcription of the air pump. Air weighed. Preſſure of the air proved by its breaking a bladder; by the double transfer; the Magdeburg hemiſpheres; the fountain in vacuo; by its forcing air and mercury through the pores of wood. Common pump illuſtrated by a model. Reſiſtance of air; reaſon why all bodies do not fall equally quick; a guinea and a feather, in an exhauſted receiver, fall together. Mills. Cork and lead balanced.

Spring of the air equal to the preſſure; proved by a variety of experiments; particularly by its ſupporting a column of mercury of the ſame height with the barometer; by the half exhauſted bladder; the bolt head and bottle—fountain by the ſpring of the air; bladder glaſs; and by its being able to raiſe great weights.

Spring of air increaſed by heat; ſhewn by the two glaſs balls connected by a tube. The air may be condenſed as well as rarified. Condenſing ſyringe. Fountain by condenſed air; plays with a number of beautiful jets. Experiments with the air gun. Analyſis of atmoſpheric air.

Chemical properties of different airs; particularly fixed air; or carbonic acid gas, oxygen gas, or dephlogiſticated air; hydrogen gas, or inflammable air, &c. Nature of reſpiration. Effect of vegetables in purifying the atmoſphere, owing to their decompoſing water. View of modern chemiſtry: its application to medicine and agriculture. Theory of the winds: Dr. Halley's unſatisfactory: that lately publiſhed by Dr. Darwin accounts very well for moſt of the phenomena. Undulation of the air. Sound. Muſical ſound. Theory of muſic.

SECT. VI.

OF HYDROSTATICS AND HYDRAULICS.

The preſſure of fluids proved to be as their depth, without regard to its direction. The hydroſtatic paradox, or the preſſure of a fluid proved to be as its altitude, without any regard to its quantity. A ſolid immerſed in a fluid loſes a certain part of its weight. The theory of the hydroſtatic balance, or the method of finding the ſpecific gravity of different ſolids, whatever may be their form. Hydrometer. Method of diſcovering the ſpecific gravity of fluids, ſtrength of ſpirits, &c.

The principles of hydroſtatics illuſtrated by Faux's figures. Theory of the ſyphon. Tantalus's cup. Intermitting ſprings explained. Pumps—common—forcing—De la Hire's—Taylor's, which is now uſed in the Britiſh navy. Theſe different kinds of pumps illuſtrated by working models.

SECT. VII.

OF OPTICS.

Nature and properties of light. Inflection. Refraction. Reflection. Ray of light. Effect of light on vegetables. Impreſſion on the optic nerve remains ſome time. Medium. Denſity of light inverſely as the ſquare of the diſtance from the radiant body. Angle of incidence always equal to the angle of reflection. The ſine of the angle of incidence is in a conſtant ratio to the ſine of the angle of refraction. Different refrangibility of the rays of light. Newton's theory of colours. Theory of the rainbow. Divergent, convergent, and parallel rays. An object always appears ſituated in the place from whence the rays, whether refracted or reflected, ſeem laſt to diverge.

Dioptrics.—Refraction through plane and ſpherirical ſurfaces, through glaſſes, lenſes, convex, concave, plano-convex, and concave, double convex and concave, meniſcus. Method of finding the foci of different lenſes.

Catoptrics.—Theory of mirrors, plane, convex and concave.

Viſion.—Deſcription of the eye: progreſs of the light through the eye: formation of the picture at the bottom: connection of this with viſion. Seat of viſion. Defects of viſion. Long and ſhort ſight. Squinting—their remedies. Single and double viſion. Viſion by means of glaſſes. Apparent magnitude. Field of viſion. Brightneſs.

Optical Inſtruments.—Camera obſcura. Microſcopes, ſingle and compound. Burning glaſſes.

Teleſcopes;—refracting, aſtronomical, day; Dollonds.—Opera glaſs. Reflecting teleſcopes, Gregorian, Newtonian.

Solar Microſcope.—Variety of ſmall objects magnified by it; ſuch as farina, animalculæ in fluids, mites, the pores of wood, pith, &c.—the image of a flea, when magnified by this inſtrument, will generally meaſure ten or twelve feet. The face and ſpots of the ſun (if any) exhibited. The circulation of blood in ſmall animals; and the cryſtallization of ſalts ſhewn.

The nature of viſion is illuſtrated by a beautiful artificial eye, exactly reſembling the natural one; and by models of long, ſhort, and good ſighted eyes.

The nature of teleſcopes, microſcopes, &c. is ſhewn by models in which the rays of light are repreſented by ſilk ſtrings; by which means this branch of ſcience is rendered perfectly plain to thoſe who have not ſo much as thought on the ſubject.

SECT. VIII.

OF MECHANICS.

Of motion and its affections, viz. velocity and momentum. Laws of motion. Attraction of gravitation, increaſes inverſely as the ſquare of the diſtance. Of the deſcent of bodies, uniformly accelerated by the force of gravity. The ſpace deſcribed by falling bodies is as the ſquare of the time, from the beginning of the fall. The force of gravity not the ſame in all parts of the earth. Centrifugal force of bodies, greateſt at the equator. Gravitation not confined to the earth, but extends to the planets.

Of the mechanical powers, viz. the lever, wheel and axle, pully, inclined plane, wedge, ſcrew. No real gain of force by mechanical contrivances, the power being only applied more conveniently; for what is gained in power is loſt in time. Perpetual motion—impoſſible. Of the center of gravity; line of direction. Rolling bodies. The double cone and cylinder. Of pendulums; their vibration in a cycloid. Of projectiles. Theory of Gunnery, of little uſe for directing the practice. Obſervations on wheel carriages.

FINIS.